higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MECHATRONIC SYSTEMS
NQF LEVEL 3

(6040213)

21 November 2018 (X-Paper)
09:00–12:00

This question paper consists of 7 pages.

NCV

TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Write neatly and legibly.

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QUESTION 1

FIGURE 1 shows a control cubicle where a fan is installed to ensure the temperature is kept at a constant temperature.

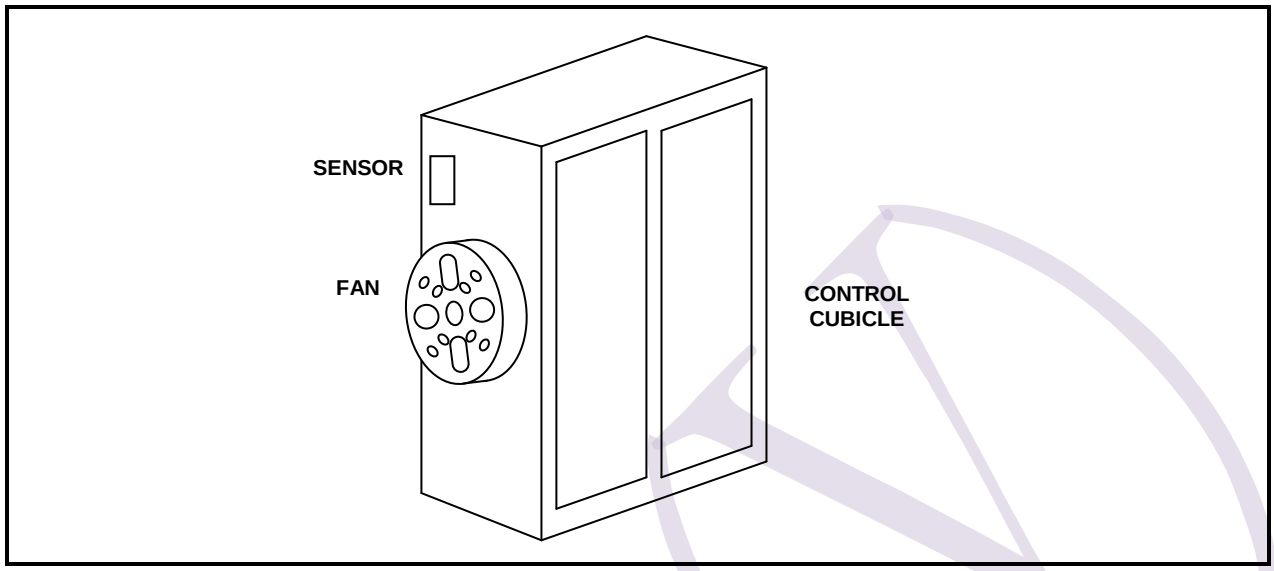

FIGURE 1

1.1 Draw the electronic transistorised fan control circuit of the control cubicle using a thermistor. (10)

1.2 Thermistors are used to turn on/off components and subsystems for protection or control applications.

1.2.1 Explain the operation of a thermistor with respect to a positive temperature coefficient (PTC). (2)

1.2.2 Draw the PTC characteristic curve of a thermistor. (2)

1.2.3 Name TWO other resistive devices used in electronic control applications. (2)

1.3 Explain how the electronic temperature control circuit can be tested using the black box approach considering the input and output signals. (4 × 1) (4)

[20]

QUESTION 2

2.1 Name THREE types of electric motor drives used for the fan system mentioned in QUESTION 1.1. (3)

2.2 Why is it not necessary to use a servo or stepping drive (stepper drive) in the fan system mentioned in QUESTION 1.1? (2)

2.3 Resistors are used for motor speed control in various industrial applications.

Draw the simplified resistor voltage control circuit used for motor speed control. (4)

2.4 Make a neat, simplified, labelled construction drawing of a permanent DC motor drive. (5)

2.5 Briefly explain the operation of a four-step stepping motor used in an open-loop control application. (5)

2.6 Which AC motor cannot be reversed in an application? (1)

[20]

QUESTION 3

FIGURE 2 shows a simplified, manually-operated hydraulic system used in a car hoist.

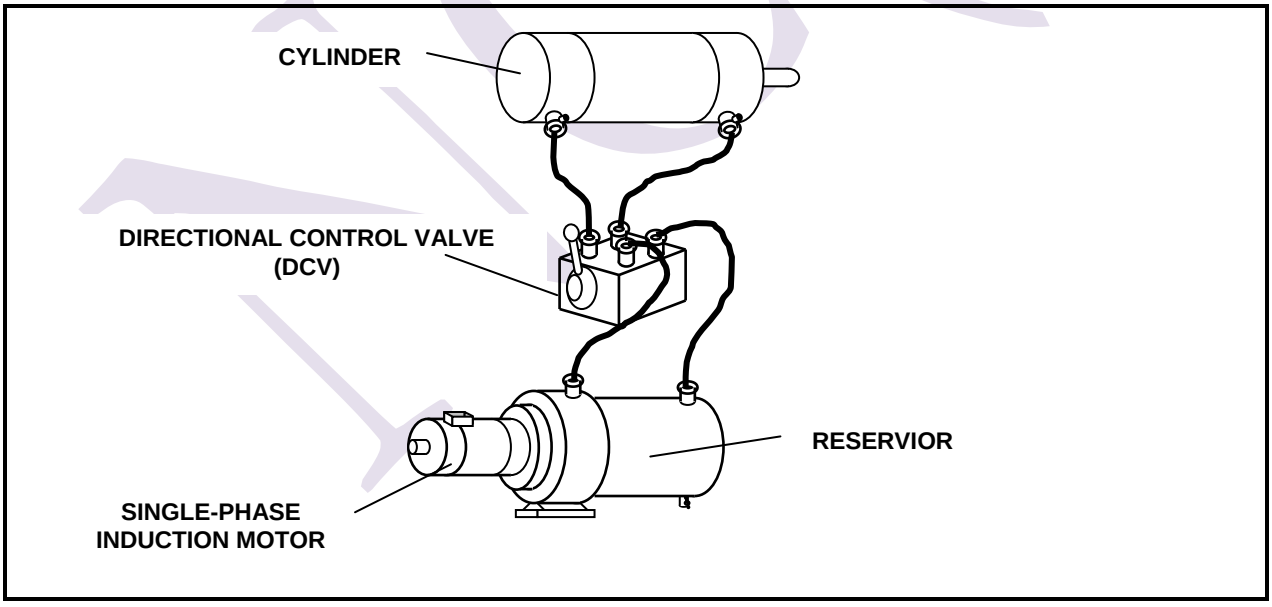

FIGURE 2

3.1 Comment on the power of the cylinder in FIGURE 2. (2)

3.2 What is the purpose of the directional control valve (DCV) regarding the control of the cylinder in FIGURE 2? (2)

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3.3 What is the function of the electric motor and the reservoir regarding the hydraulic power pack shown in FIGURE 2? (2)

3.4 Make a simplified pictorial drawing of the diagram of the hydraulic power circuit of the hydraulic connection of a car hoist.

The hydraulic circuit must include a flow-control valve to prevent the hoist from coming down too fast. (8 × 1) (8)

3.5 What is meant by the term *sequencing* when more than one load is being moved? (2)

3.6 Explain the difference between *hydrostatics* and *hydrodynamics* used in hydraulic applications. (2 × 2) (4)

[20]

QUESTION 4

4.1 FIGURE 3 shows a hydraulic ejector system.

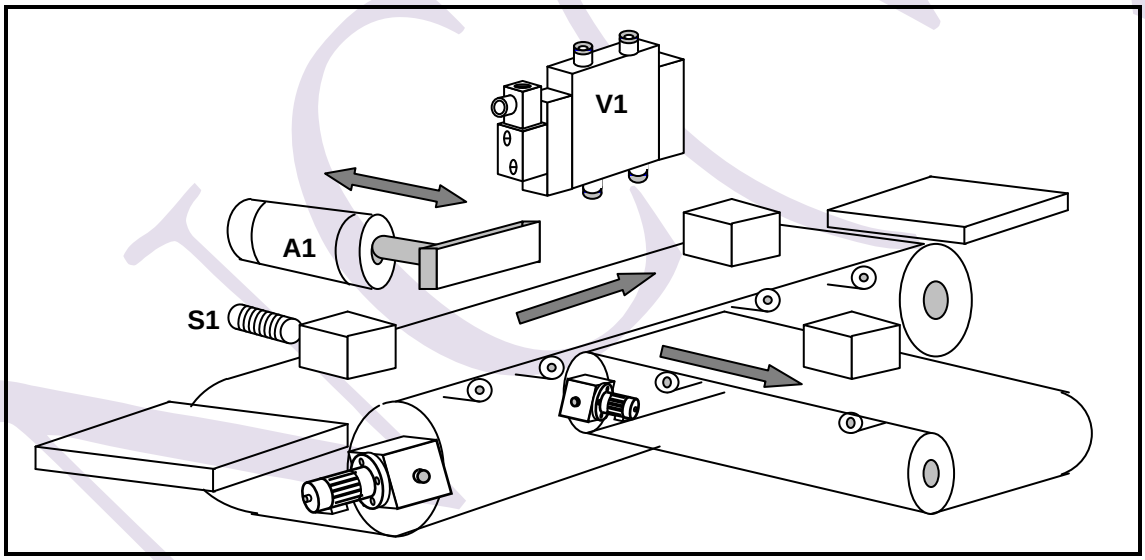

FIGURE 3

4.1.1 Draw the relay logic ladder control diagram in the distributed format to meet the following requirements:

The ejector (A1) will activate and push the workpiece onto conveyor 1 when the photoelectric sensor (S1) detects a red workpiece. The circuit includes the conveyor motor control circuit. Assume a 24 V drive. (6 × 1) (6)

4.1.2 Draw the electrohydraulic power ejector circuit. (4)

4.2 FIGURE 4 shows a control diagram of a proportional-controlled hydraulic system broken down into subsections that are more specific.

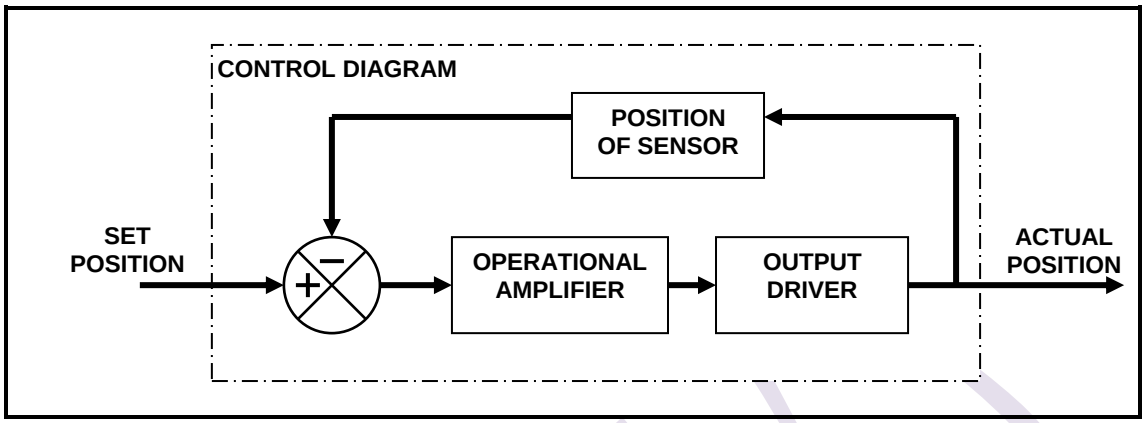

FIGURE 4

4.2.1 What type of control is shown in the control diagram? (1)

4.2.2 Explain the operation of the comparator in the control diagram. (4)

4.2.3 Explain the difference between *overshoot* and *undershoot* as used in proportional control applications. (2 × 2) (4)

4.2.4 What does PID mean in proportional control applications? (1)

[20]

QUESTION 5

5.1 State FOUR electrohydraulic machine malfunctions. (4)

5.2 Electrohydraulic machine malfunctions may be attributed to underlying causes of flow, pressure or direction.

What underlying cause can be related to the following malfunctions:

5.2.1 Slow actuator speed

5.2.2 Wrongly adjusted relief valve

5.2.3 Leaking pipe

(3 × 1) (3)

5.3 Explain the difference between *cause* and *consequence* related to an electro-hydraulic system malfunction. (2 × 2) (4)

5.4 Electrohydraulic systems are made up of a hydraulic section and an electrical section.

Determine the flow chart that should be followed when servicing the hydraulic section. (7 × 1) (7)

5.5 Name TWO areas that should be checked when servicing the electrical section of an electrohydraulic system. (2)
[20]

TOTAL: 100

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